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THE NATURALIZATION OF ROADBANKS

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By

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A naturalized road bank harmonizes with its surroundings and gives the appearance of completeness to road construction, as on this beautiful stretch of roadway in the Cherokee National Forest of Eastern Tennessee.

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I N T R O D U C T I O N.

IN OLDER COUNTRIES the naturalized road bank is more frequently seen than are the bare raw banks that characterize public highways in most hilly and mountainous sections of the United States. But here, quite as commonly as abroad, the naturalized road bank, with its universal appeal to the great traveling public, should be the normal condition and not the lamentable exception. It is a mistake to assume that bare banks are a necessary evil in road construction, even on main highways. With a truly inconsiderable additional effort and expense, naturalized road banks may present along all our roads a continuous display of native plants, with different wild flowers and shrubs coming into prominence in the successive seasons.

MUCH OF THE APPEAL of national forest and national park roads is due to the care given by the road engineers to this phase of construction. What is lacking elsewhere is the recognition by the generality of road builders that road-bank stabilization is a legitimate and essential part of road construction. Once the bank is stabilized, little additional effort is needed to encourage a permanent natural cover of local shrubs and trees.

THE COST CAN BE RELATIVELY LOW if the method followed is to leave the bank in such shape as to favor the gradual invasion of local vegetation--so small a fraction of the cost of road construction as to make almost inexcusable the wounds and scars that disfigure the course of so many highways throughout the land. In addition to the inestimable gain in aesthetic values, the naturalized road bank has a very practical and utilitarian value, determinable in dollars of maintenance costs per mile of roadway saved. Eroded soil from bare banks on many mountain roads in the southern Appalachians, by choking ditches and culverts and subsequently cutting out fills, has cost each year $100 to $300 per mile of roadway in maintenance. Where vegetation finally has pushed its way onto these bare banks, halting erosion of the remaining

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A naturalized road bank may become so well blended into its surroundings as scarcely to be distinguishable from a natural slope.

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In sorry contrast to the above is a long line of exposed road banks such as this, too common a sight in mountain country. These gashes, sometimes visible miles away, will persist for decades as ugly scars on an otherwise inspiring landscape.

soil cover, maintenance costs have fallen to a small fraction of the former avoidable expense. Many hidden costs too, are chargeable to bare road banks. These mount high in silted reservoirs, clogged streams, and ruined adjacent arable lands. Slips of the bank surface, smearing clay and mud across the highway, cause serious or fatal accidents.

ON FEDERAL LANDS naturalization of road banks has already proved its economic worth and aesthetic value in solving many difficult problems of road construction, attracting the attention of roadway engineers throughout the country, and arousing much public interest. Already much effort has been put into this form of stabilization--in some places with high success and at very reasonable costs. Elsewhere the treatments, although successful, have proved to be far too expensive for general use. In numerous other instances, treatments have not produced satisfactory results regardless of cost. It is apparent that road-bank naturalization involves certain new techniques which must be recognized and practiced to assure success.

SEVERAL AGENCIES HAVE CONTRIBUTED to the development of these techniques. The Watershed Protection Section of the Tennessee Valley Authority, the National Park Service, and the Soil Conservation Service have all had an active part. The landscaping sections of the State highway departments have for many years been doing excellent work in highway landscaping and of late have begun stabilization as a first step towards erosion control and reduction of maintenance costs. The Highways Research Board of the National Research Council has also taken active interest in road-bank naturalization.

A STUDY OF STABILIZATION TREATMENTS was begun in 1934 by the Appalachian Forest Experiment Station, testing the different methods suitable for national forest roads and truck trails, and from this study very practical results are now available. Plot trials of various treatments have been carried out on several experimental forests, and extensive tests of the results have been made on hundreds of miles of national forest roads.

THESE EXPERIMENTS HAVE RESULTED in the working out of certain principles that are here presented, primarily for the use of those engaged with the practical problems of the road-building job. They are concerned first with the factors limiting plant growth and then with naturalization measures, which fall naturally into two classes--those involved in the location and planning of roads, and those concerned with the establishment of the healing and screening vegetation.

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Excessive bank cutting is sometimes inevitable in the construction of high-standard roads in rough terrain, but even here naturalization is not only possible but imperative, to restore the beauty of the landscape, to avoid stream siltation and erosion, and to do away with ruinous upkeep expense on the highway.

One grave consequence of road banks left unrestored is clayey soil washed onto the highway. This can be the cause of fatal traffic accidents. Provision must be made for the immediate removal of such material. In the section pictured this road machine must be called into operation after each heavy storm.

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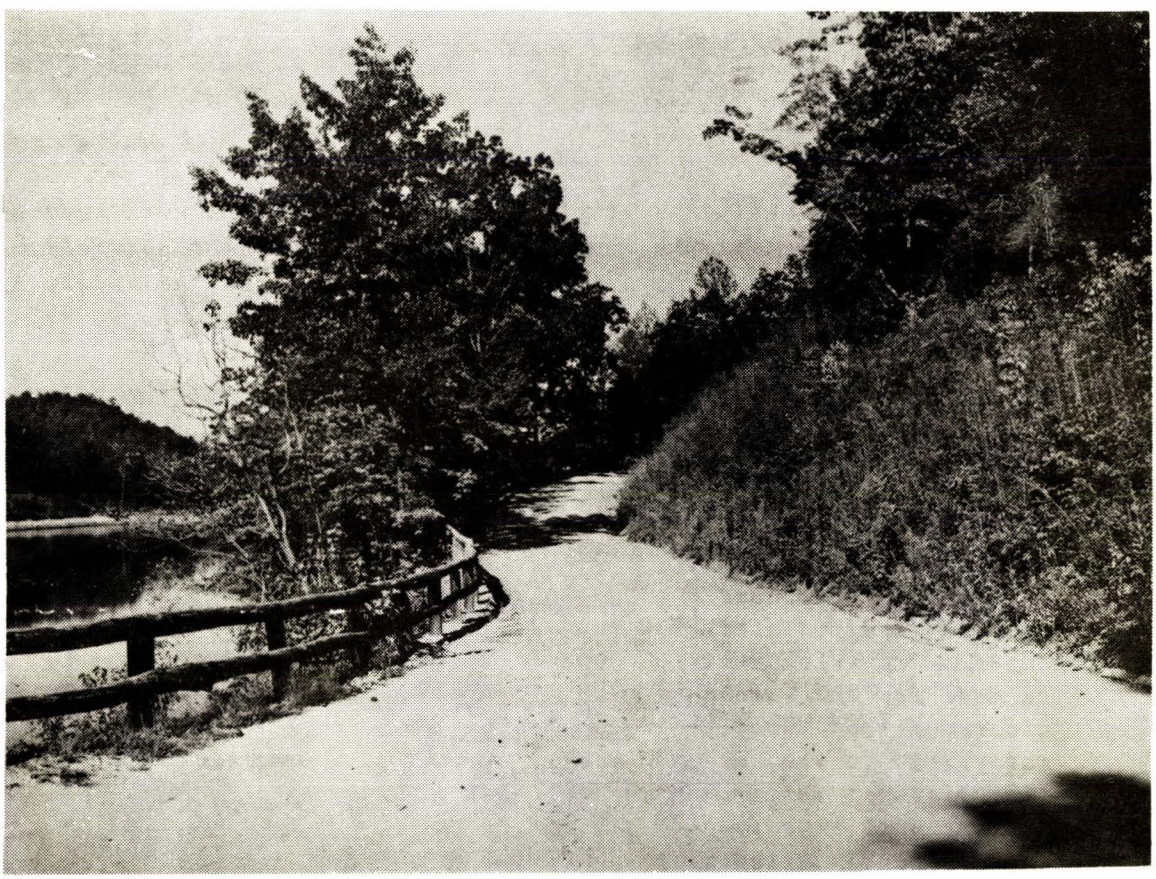
THE DISCUSSION TO FOLLOW is directed to the cut bank rather than to the fill. This is because the fill may be naturalized by any of the measures proposed for the cut bank when any particular problem of fill naturalization is present. With adequate rainfall, the fill is much more easily naturalized than is the cut bank and seldom is difficult to stabilize after adequate road drainage has been provided. Exceptions to this rule occur on long steep fills occasioned by extra heavy road construction in dry regions. Here special mechanical structures may be needed, such as cribbing and retaining walls. Structures of this type are considered as being beyond the scope of the present discussion.



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Even a first-season's growth of short-lived weeds is sufficient to hide the raw scars of the road cut and to restore the charm of a pleasing vista. Soon more permanent plants will come in, to complete the work of restoration.

FACTORS LIMITING PLANT GROWTH

THE CHIEF FACTORS LIMITING PLANT GROWTH on road banks are soil instability, insufficient soil moisture, and inadequate soil fertility. On some banks these factors may so operate from year to year as to preclude the possibility of natural vegetation ever becoming established.

IN the Tidewater Counties of Virginia are road banks that have remained bare of vegetation for more than a century and a half because of the unstable condition of the surface soil. The principal factor here has not been one of fertility or of moisture but rather of sloughing caused by repeated deep freezing and thawing.

IN the southern Appalachians many banks are known to have been bare since the memory of the oldest inhabitants of the locality. Such banks are continually being reduced by gradual erosion; but the change in appearances is so gradual that it frequently escapes attention.

A REVIEW in detail of the principal factors responsible for such havoc on old and more recently built roads, with some illustrations of their operation, will make clear the fundamental obstacles in the way of road naturalization and how to avoid them.

INSTABILITY OF SURFACE SOIL is the natural condition for all exposed soil subjected to the stress of alternate freezing and thawing, wetting and drying, and the mechanical effects of wind and driving rain. It opens the way to exposure of plant roots through frost heaving and the washing of soil from around the roots. As a rule, the steeper the slope the more disastrous the results.

Honeysuckle root clumps planted 3 years before in deep holes on the upper slope of an eastern Tennessee clay bank here testify that 10 inches of surface soil have been washed away in that time.

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On a bare road bank, formation of ice crystals is accompanied by lifting of rock and soil particles, which slough down into the drainage ditch. If the slope is steep, shallow-rooted vegetation will not be sufficient to prevent this action.

OVERCOMING INSTABILITY is a matter of encouraging the growth of deep-rooted vegetation on the slope, or covering the bank with a blanket of organic material to serve as a mechanical protection. Soils devoid of organic material are generally more subject to erosion than soils abundantly supplied with it. The gradual mingling of any kind of organic debris with the bank soil is beneficial.

A common winter sight in the frost belt is the road ditch completely filled with sloughed bank material. The ice crystals that cause this sloughing may disappear during the day and form again at night 50 to 75 times in a single winter.

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The material thrown down by alternate freezing and thawing, collecting as a loose talus in the ditch at the foot of the slope, is easily carried away during heavy rains. For this reason the mass of material being eroded may be greatly underestimated.

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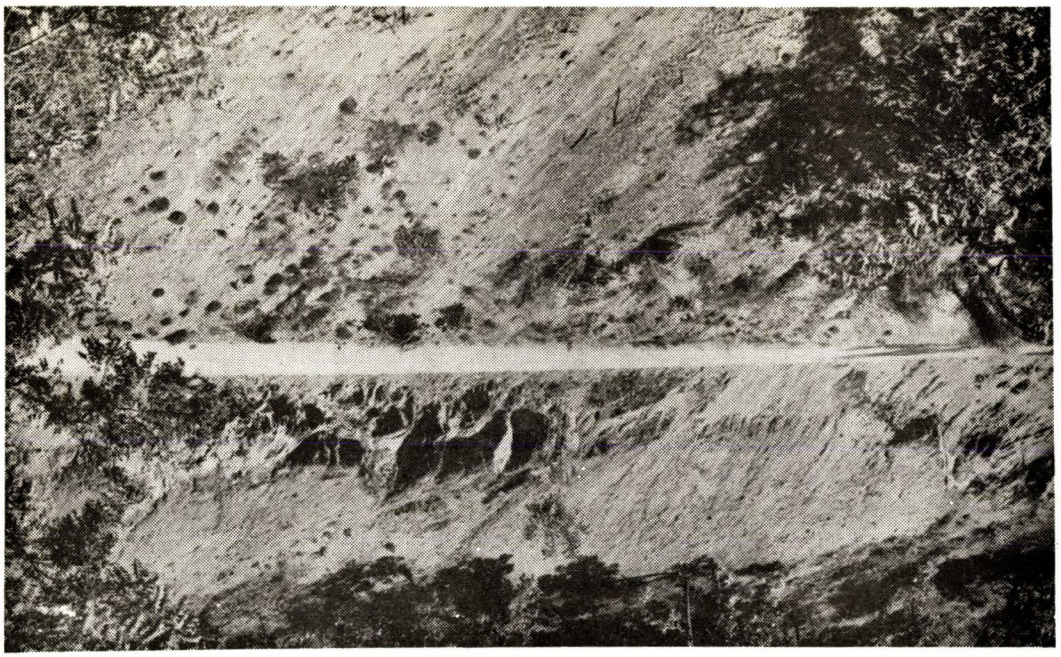

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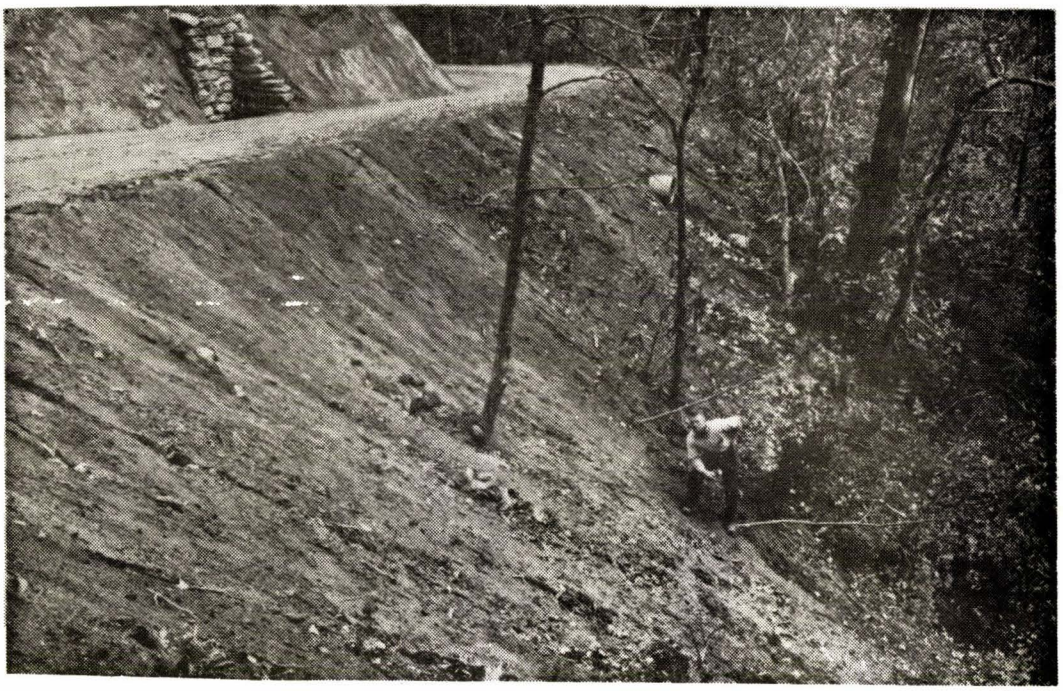
On crumbling shale banks it is difficult for natural vegetation to get established without some special assistance from the roadway engineer.



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Unprotected loose fills erode severely, making a quick-growing vegetative cover essential.

INSTABILITY MAY GO DEEPER

than the surface soil of the road bank, and manifest itself in major slides that no formation of vegetation cover will alone correct. Construction of roads through a rough terrain may cut off the supporting toe of long talus slopes and so result in continuous sliding. Occasionally deep clays, particularly those formed in situ and characterized by shearing planes such as are formed in the older Appalachian mountains, are also rendered unstable by road construction, resulting in large scale slides and mass movement of soil sometimes completely blocking the highway.

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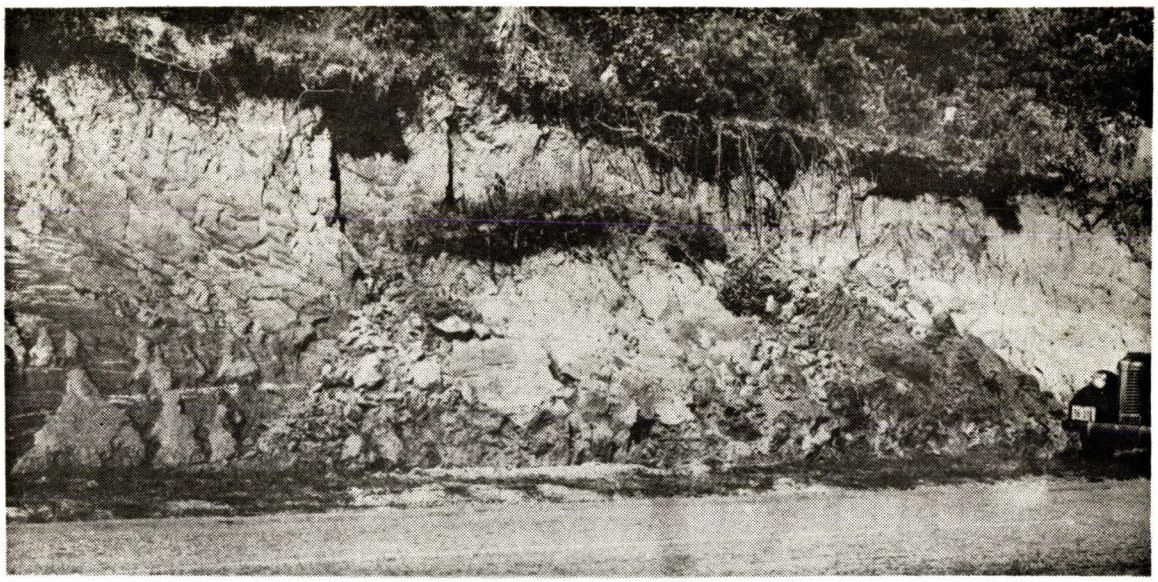
This constantly eroding bank is a result of inadequate sloping. The original slope at the time of construction may be seen to the right of the center. The higher bank in the center has suffered from constant sloughing and sliding, until to halt the damage done by weathering would be a costly operation of doubtful outcome.



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Instability of steep banks of deeply weathered soils is evidenced by frequent caving and slumping, and by the subsequent blocking off of the upper bank after the base has been undermined.

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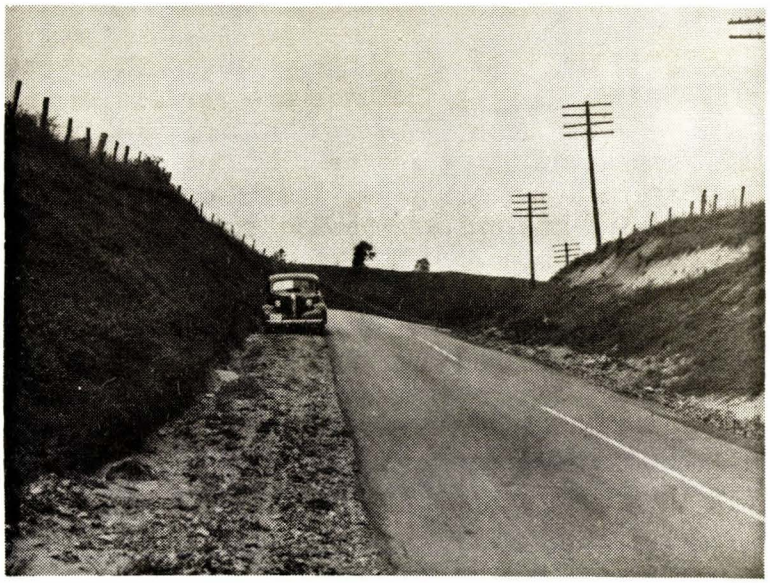
For steep banks subject to continuous erosion, sloughing and caving, it is impossible for natural vegetation to gain a foothold until after the entire bank has been thrown down to an angle of repose.

LACK OF MOISTURE due to excessive evaporation and drainage often renders road banks too dry for naturalization or plant growth of any sort.

IN all such cases of deficient moisture the upper slopes will obviously be much drier than the lower, and the south-facing banks much drier than the north-facing. Treatment to stabilize the slope in one case may not apply in another; each presents an individual problem.

ONE of the most expedient methods for overcoming this difficult condition is the use of organic mulches to conserve whatever moisture reaches the slope.



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Insufficient moisture may be the only limiting factor, as on the east-west cut where the north-facing bank supports vigorous growth of honeysuckle, in marked contrast to conditions on the opposite bank.

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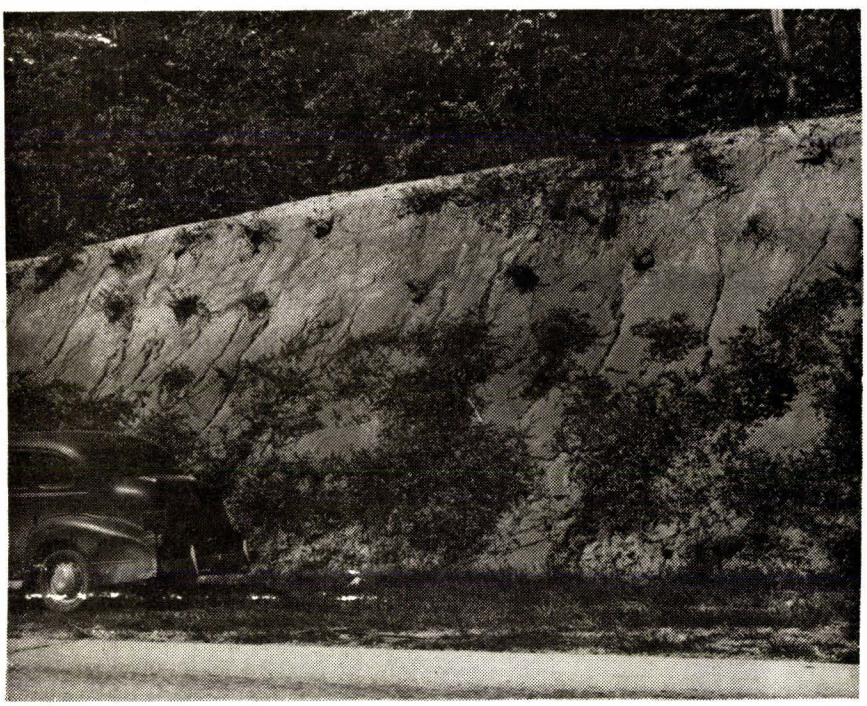
South- and southwest-facing banks that have little water percolation from above are often too dry for growth of any kind; such banks can only be resloped and mulched to obtain enough moisture to favor plant growth.

INFERTILITY IS TOO OFTEN BLAMED for poor growth on road banks when the real causes are surface instability and lack of moisture. This mistake is often made in judging road-bank conditions in the piedmont and southern Appalachian regions. Vegetation has established itself on these "infertile" banks as soon as mulching has halted erosion and started to hold moisture.

EVEN though the new growth may be composed largely of dewberry and weed species characteristic of poor sites, these species serve to naturalize the bank and prepare the way for other plants. In fact, it may be advantageous on most road banks to obtain plant species of low fertility requirement for the first few years, until this growth has encouraged site improvement.



Although the poor growth of this root-clump planting of honeysuckle appears to be due to infertility, it is actually brought about by soil instability and lack of moisture.

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UNDER natural conditions, any improvement of fertility comes largely from organic material in the form of wind-blown leaves or other litter and from the biological activity that accompanies the decomposition of such material. Even relatively sterile mineral soil is improved in fertility under a protective cover of organic material. The steeper the bank the less organic material can find lodgment and no improvement in fertility can take place.

HIGH FERTILITY IS UNPRACTICAL on road banks as a rule. It is sufficient if the bank will support plant growth of any kind. Where mulching fails to improve surface stability and moisture, top dressings are most useful. The best treatment for such unusually sterile banks might be a dressing that combines the characteristics of an organic mulch with those of a rich topsoil with abundant plant nutrients and biological activity. Such dressings are usually available within working distance of the road.

Honeysuckle root-clump plantings in condition similar to those on the opposite page were greatly increased in vigor by mulching the bank with roadside mowings.

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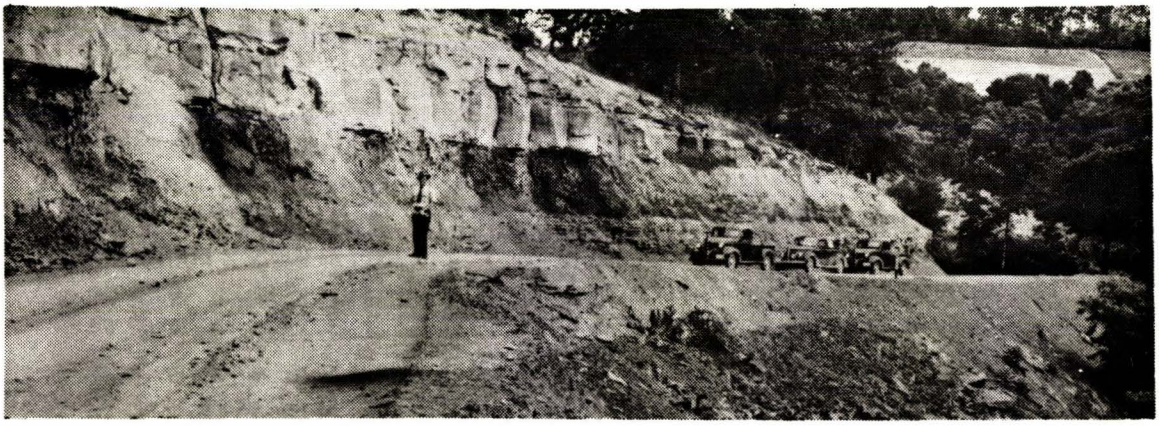
SOIL infertility merits particular attention on large banks where much of the exposed slope is representative of the lower soil horizons. It is manifestly impossible, however, to formulate specific solutions for all the conditions that may be encountered.

A BASIC consideration is that banks exposing B-horizon soils or lower are improved by the incorporation of some A-horizon soil or other organic top dressing and commercial fertilizer. Necessity for such improvement in any specific case depends upon local conditions.

PLANNING FOR ROAD-BANK NATURALIZATION

STABILIZATION AND NATURALIZATION of road banks should be regarded as not merely providing vegetation, but involving as well the complete coordination of both engineering and vegetation-establishment techniques. In short, the engineering job is no longer on a cut-and-run basis, but rather extends up to and includes restoration of the landscape. Once this viewpoint is accepted, naturalization becomes a part of the road plan.

LOCATION OF THE ROAD is the primary consideration, since bank conditions left after the road is finished will largely determine the treatment to be given the bank and, so far as possible, must be taken into account in planning the road. For example, knowledge of the geology of the region makes it possible to avoid difficulties such as that pictured below. Again, careful planning avoids excessive bank cutting and rugged terrain and so reduces the cost of naturalization.



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Here, rotten shale underlying the rock ledges disintegrates so rapidly as to cause constant falling of the heavy rock above. To protect traffic, the entire ledge should be moved back.

POSTPONING BANK STABILIZATION may result in its having to be undertaken after erosion has wrecked both cut and fill. The present trend in new construction is to plan ahead and to begin road-bank stabilization with the determination of road location and the adoption of standards of construction. This is the greatest single thing an engineer can do to insure bank naturalization.

AT this stage, numerous measures should be incorporated into construction plans that will promote naturalization. If these are carried out while the construction work is in process, adequate stabilization may be achieved at little or no additional cost.

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Group study of principles and their practical application feature Forest Service road engineering.

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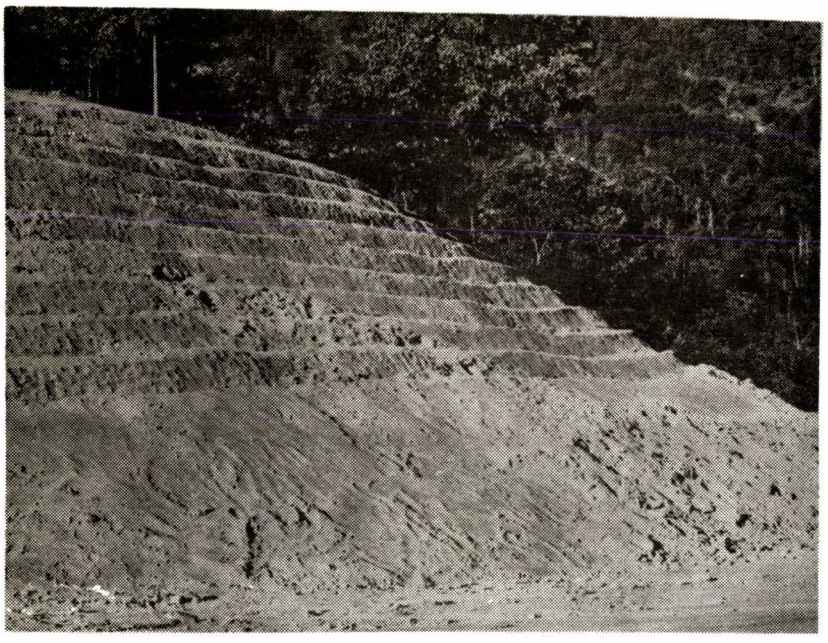
Roadway widening offers opportunity to instruct local foremen in simple stabilization measures that will insure naturalization of banks.



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Had naturalization of the bank above, including proper sloping and surfacing, been part of the road plan, as in the case of the bank below, the additional cost would have been insignificant compared to the expense of this hand job of resloping and terracing, which is only the first step towards stabilization and the naturalization so easily attained on the road pictured below.

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THE PLAN should include provision for disposal of the dirt excavated, protection of fills from stream erosion and other heavy work most economically done by power machinery. Good machine operators can do much to reduce subsequent cost if they are informed of erosion control objectives and methods. An operator of a trail-builder on a widening job can cut slopes in a series of small terraces leaving considerable loose dirt, thus providing very favorable conditions for revegetation.

GOOD DRAINAGE is imperative if road-bank stabilization is to be succesful. Although beyond the scope of this discussion, the subject deserves brief comment. Faulty drainage, permitting concentrations of water to pass over the bank or fill, may render stabilization impossible, or greatly increase its difficulties. Lack of head walls above culvert inlets may cause undercutting and result in sloughing of the bank. Omission of aprons below culverts will produce similar fill erosion. Inadequate cross drainage often results in damage to the fill as well as to the ditches and road surface.

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A well laid head wall will keep the bank from being undermined at the culvert inlet and the intake from closing. The drop inlet and the step construction also help to keep the intake open.

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A lined road ditch under a stabilized bank eliminates all further trouble from erosion.

CONSERVING NATURAL TOPSOIL is a simple matter if naturalization is coordinated with new construction, since it may be readily obtained from the right-of-way clearing, along with needed brush and other native materials. Cost can be held down by handling the topsoil with machinery and avoiding long hauls--- on new jobs, by stock-piling or shoving it to one side as the work advances. It should not be allowed to leach out in successive rains or dry out all its biological activity. On old banks, sufficient topsoil can usually be obtained by rounding off the upper shoulder and raking it down over the roughened and loosened bank. The volume of topsoil is not so important as its freshness when applied and its permanence thereafter.

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If care is taken to push the topsoil aside into stock piles when the new construction is started, it can be reapplied as a top dressing after the bank is sloped and roughened.

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Slope at left received two inches of rich topsoil containing an abundance of organic material; slope at right was left bare. The heavy growth of local plants on the covered slope came from seed in the dressing.

CONSTRUCTION OF STABLE SLOPES is, from the engineering viewpoint, merely a matter of cutting the road banks to a natural angle of repose for the particular soil. Actually, however, no exposed soil is stable if it is subjected to alternate freezing and thawing and to the direct action of wind and water.

IN the frost zone of the United States, a slope that during most of the year is apparently stable may suffer severely from sloughing and erosion during the winter months, unless it has been made stable by vegetation or some mechanical means that prevent surface movement.

BECAUSE lower slopes require the removal of more yards of earth at the time of construction, economy commonly dictates cutting the maximum allowable slope--a policy that sometimes leads to excessive maintenance costs later on. These steeper slopes also become naturalized much too slowly, and continued erosion from them often results in clogged drainage ditches, the washing away of road surfaces, and the cutting out of fills.

DISASTROUS results can sometimes occur when a steep bank has been sloped on the upper portion only, and the loosened material lies unpacked and deeply piled upon a steep lower slope of relatively impervious material. Such a condition is ideal for minor slides, until such time as large vegetation has become well established on the talus. The only immediate solution is either to slope the entire bank, loosening it evenly over the entire surface, or to prepare, by means of shelving or deep furrows, a firm tie between the talus and the bank.

THE most practical slope for roadbank stabilization is that which most favors vegetation establishment and yet involves no unreasonable construction costs. Here, as elsewhere in the process of bank naturalization, there is no fixed rule applicable to all situations. Some indication of how treatment must be varied to obtain even tolerable results on different bank slopes encountered on mountainous terrains is illustrated in Figures 1 and 2.

RESLOPING and other engineering measures are frequently necessary for old banks that have failed to become naturalized. This is particularly true where frost action and caving is active and the talus is being continually washed away. Such banks do not come to an angle of repose naturally.

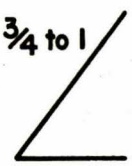
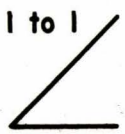
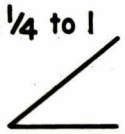
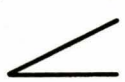
SLOPE	DESCRIPTION	TREATMENT
1/2 to 1	Very difficult & expensive to stabilize, particularly in the frost zone belt—justifiable only in exceptionally steep terrain.	To promote the invasion of natural vegetation on this slope, the surface must be scarified and held in place by a strong mulch tied in place. Can also be seeded to small grain or grasses for a temporary cover.
3/4 to 1 	Still a difficult slope to stabilize - justifiable only when normal surface is 100% or more.	Can be stabilized by a light mulch well tied in place with brush and stakes over the scarified surface. Can be seeded at once to obtain a temporary cover.
1 to 1 	Requires careful and expensive treatment.	Can be stabilized with a strong weed mulch and a few stakes, or with lighter mulch of litter covered with brush.
1 1/4 to 1 	A practical slope for most construction.	Light mulch is sufficient, with a minimum of tie material and staking.
2 to 1 	Adapted to machine sloping for low banks.	After machine sloping, the surface may require roughening; then seed.
4 to 1	Use whenever the ground surface is less than 50%.	No other treatment is necessary if the surface is well loosened; may be seeded or planted at once.

Figure 1—Schedule for the stabilization of moist banks having deep, rich soils. Natural vegetation will come in readily on such banks at almost any angle if the surface is properly protected. The treatments needed are those that will insure stability of the surface soil, so that seedlings can become established. Loose organic mulches are adequate for this purpose.

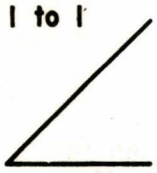
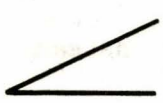
SLOPE	DESCRIPTION	TREATMENT
1/2 to 1	Impracticable slope to obtain surface cover if south-facing; must be resloped if vegetation is desired.	On very dry sites the slope sometimes holds without treatment if the soil is such that it does not erode easily either by wind or rain. If the soil is unstable and subject to caving the bank must be resloped to a lower angle.
3/4 to 1	Difficult and expensive to stabilize; must be improved in moisture by mulching; heavy application of topsoil inadvisable.	Requires a light top dressing of 1 inch of rich soil over a loosened surface; then a mulch of only the strongest tie materials, such as a loose litter under a surface framework of poles and stakes; fertilize when seeding.
1 to 1 	Steepest slope recommended, but difficult to hold topsoil in place.	Loosen surface and apply one inch of topsoil; mulch and tie well in place with poles and stakes.
2 to 1 	Use whenever ground surface is less than 50% on banks up to 4 inches; topsoil is easy to control.	Loosen, apply fertilizer and seed; use light mulch on soils drier than average. Can apply any amount of topsoil desired.
4 to 1	Use where ground surface is less than 20%, etc.	Cultivate with farm machinery; drill in fertilizer and seed.

Figure 2—Schedule for the stabilization of dry banks having relatively sterile soils. Natural vegetation will come in only if the soil moisture is improved and the surface loosened, protected, and fertilized. Top dressings of soil rich in organic material, or light mulches of weeds and woods litter will provide the best growing conditions on dry banks. The objective is to place these dressings on the bank with as little cost as possible, and to so handle the job that it will become a part of roadway construction.

LEAVING ROUGH SURFACES is required practice for satisfactory road-bank naturalization. The idea seems all too well established that a smooth polished road bank is the sign of good construction. This is partly because contractors are complying with slope specifications most easily measured on a smooth surface, and partly owing to the desire to leave an appearance of precision and to remove loose material that might wash from the bank.

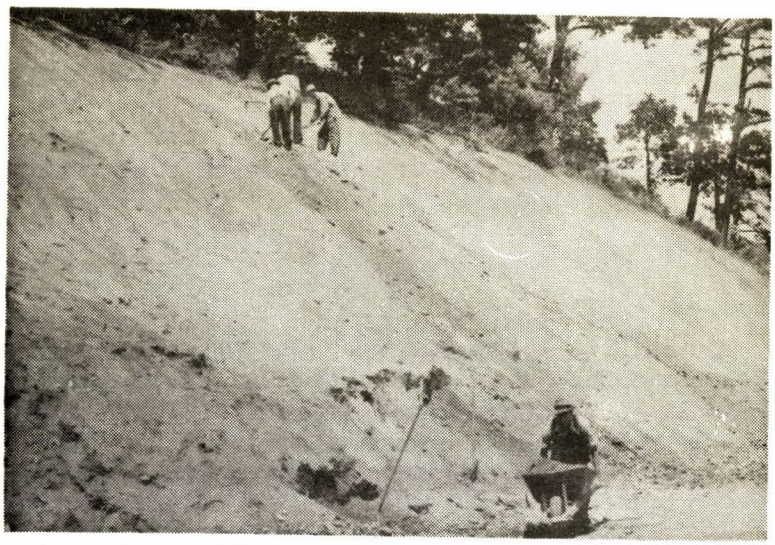
SUCH practice is not likely to be altered until specifications for the road design are altered. Road engineers must first accept naturalization of banks with vegetation as a necessary part of road building. A great deal of inertia must be overcome before specifications can be generally obtained that favor rather than hinder naturalization.

ACTUALLY, the smooth bank is in most cases quite temporary, lasting only until the first frost action and heavy rains have had an opportunity to loosen the surface, after which gully erosion and frost sloughing will necessitate constant maintenance. Certainly, no vegetation can come in naturally on polished banks till destructive influences have torn down the surface. A very considerable economy would be effected--especially if construction and maintenance costs are given equal consideration--by expending the equivalent of the labor required to put the final polish on the slope, in applying instead a top dressing and the protection of a simple organic mulch.

ROUGHENING and loosening the slope is a wise precaution to obtain stability between a topsoil dressing and the bank surface. A rough bank favors the collection of litter and wind-blown seed, and increases the infiltration of water that would otherwise flow over the surface.

USE of the common mattock for shaping cut banks has led to excessive smoothing off of every irregularity that might lodge falling leaves or catch wind-blown seed. The mattock is useful, but a pick is also valuable in loosening the surface. Consequently, the pick-mattock, rather than the common ax-mattock, can be used most advantageously.

This entire bank could have been well naturalized for the cost of the precision-like but impermanent polish being given to the slope by these workers.



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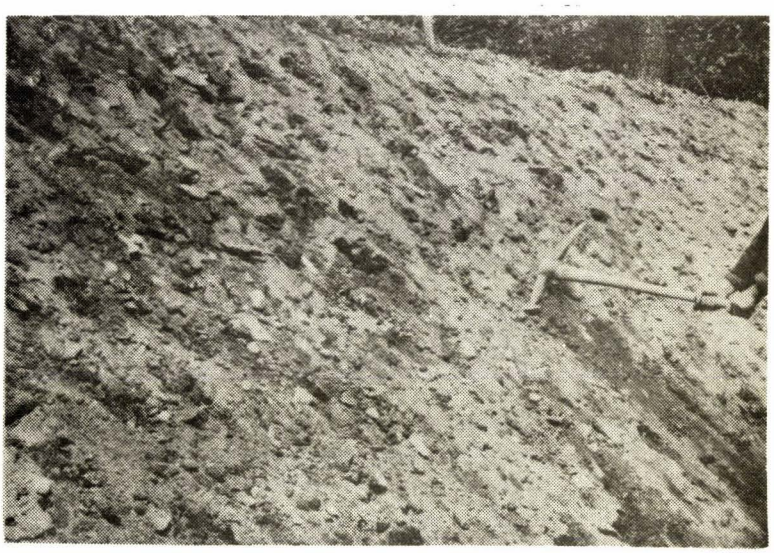
Here, all loose material is being swept from the bank and hauled away, making later naturalization of this road bank as difficult as possible.

F-403612

Loosened banks have not the mathematical precision of polished surfaces, but constitute the first long step towards a vegetation cover and greatly reduce maintenance costs. Loosened banks should be protected with a mulch cover at once.

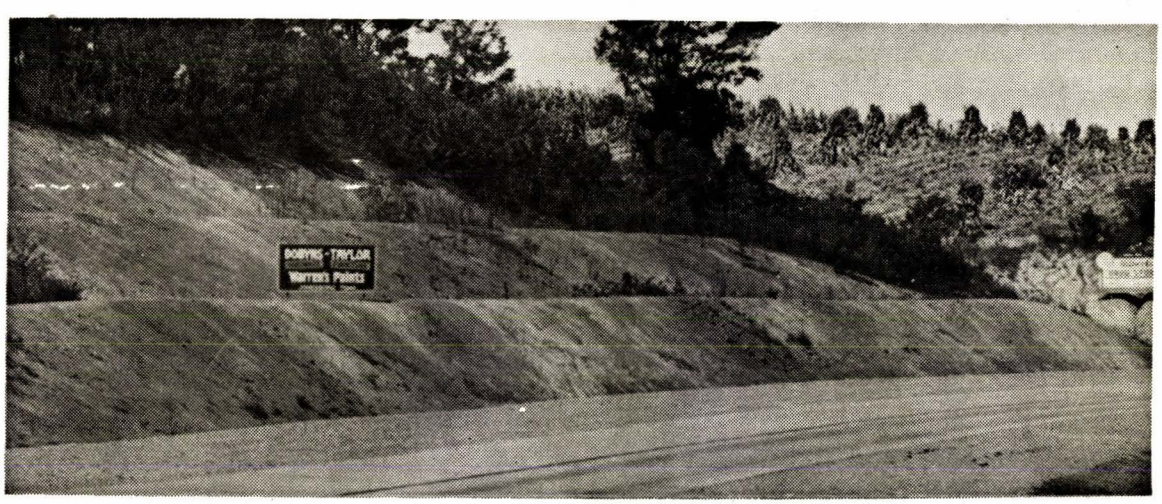


F-403627

MACHINE TECHNIQUES that help in getting away from smooth uniform slopes should be further perfected. Most road graders are now being made so that they may be used for sloping low banks to the drainage ditch. By manipulating the blade at different angles it is possible to leave the bank relatively rough.

BENCHING the cut slope is practiced to give greater visibility or to obtain large quantities of easily available material for grade construction. Benching as a useful technique for bank stabilization, although not a common practice as yet, has been used very successfully. For soils that remain stable when the slope is steep, step benching accomplishes two purposes--it favors natural vegetation establishment on the level step surface, and at the same time avoids erosion on the riser.

TECHNIQUES of benching a long high bank are already known to most machine operators. It is only necessary that at the time of cutting the slope they be instructed to leave a bank rough instead of smooth. With a trailbuilder, leaving loose material on the series of benches, naturalization can be obtained with no further treatment and no additional cost. Construction with large shovels makes it possible to leave the banks as rough as desired, and, although a certain amount of shaping is necessary, it is as easy to leave a roughened as a polished surface.



F-403620

Benching becomes an aid to road-bank naturalization on long difficult slopes. A benched slope improves soil moisture and favors plant establishment.

VEGETATION ESTABLISHMENT

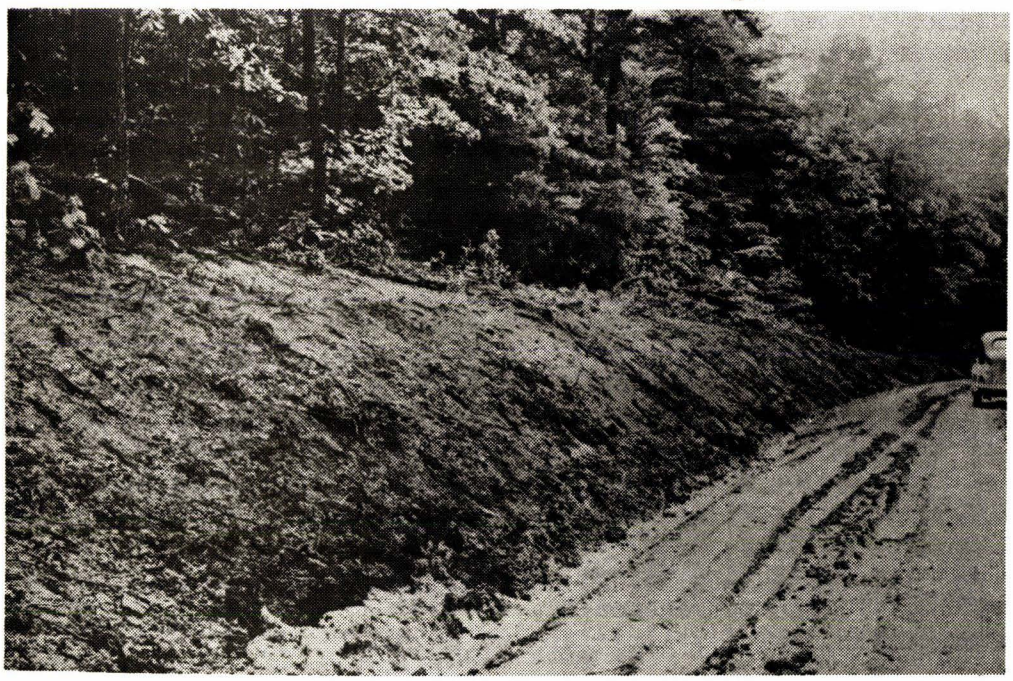
INVASION OF NATURAL VEGETATION is to be expected in localities of moderate rainfall, on banks so prepared as to favor such growth. The local vegetation that will establish itself in this way and will persist is probably the best obtainable for the particular local conditions and will produce a bank cover that will best harmonize with the adjacent landscape.

THIS invasion of local species will occur on banks that to any degree favor vegetation, regardless of what other species may have been planted when the cut was made, and in time they will occupy the site. In all preparatory work the local species should be favored rather than the outsiders.

TREATMENT to obtain vegetation on road banks is most practical when it favors this natural invasion of local species and obviates the necessity of artificial seeding or planting. The following recommendations on the use of various aids to vegetation establishment are for the most part directed solely towards building up and restoring conditions on the road bank that will come as close as possible to duplicating natural conditions of surface-soil fertility, penetrability, and permanence. Where this is accomplished, nothing further in the way of artificial aid is required.

TOP DRESSINGS are essential where it is desired to hasten the processes of invasion described above. The ideal dressing to promote naturalization on a sterile road bank consists of surface soil composed largely of organic material containing an abundance of plant roots and stems. Such a dressing combines the good qualities both of a rich soil and a mulch; the organic material has the binding and at the same time the protecting effect so needed to give seedlings a chance to become established. At the same time the roots and stems continue growth on the new location and thus greatly accelerate the naturalizing process with a minimum of effort.

TOP DRESSINGS obtained elsewhere than from the soil above the slope or from stock piles conserved when the right-of-way was cleared had best be taken from a rich cove or rich bottom land, if these are to be found within a short haul of the road. The soil selected should be as rich as possible in roots and stems. In no case is it feasible to take soil from a depleted, abandoned field merely because it is near at hand. This is poor economy, since such soil, already supporting only poor plant growth, is certain to be too sterile to be any notable improvement on the soil of the cut. It is not worth transporting.



F-403565

This newly-cut, well-sloped bank was loosened and covered at once with 3 inches of highly organic soil and duff, saved from the right-of-way, containing an abundance of roots and stems and not easily eroded. Naturalization is assured.

LOOSE granular soil with little organic material makes a poor bank dressing, because of the difficulty of binding it to the bank. A single rainstorm may wash the surface soil away. When such dressings are applied to dry banks, some vegetation may start and flourish briefly, only later to succumb from lack of moisture. Also, unless vegetation on such a surface makes unusual growth the first season, frost heaving in the loose soil may uproot it.

F-403577

Organic debris raked down from the slope above and made secure has insured the establishment of a cover that blends well with that on the upper slope and will hold the surface till permanent growth comes in.

THE simplest procedure possible in obtaining a top dressing is to rake down organic material and soil from above the slope. If the soil is taken with discretion, the resulting disturbance will be negligible. On land that has been cleared, the soil may be spaded up from a series of small holes. On forested land, the best practice is to use a cutting rake, which will collect the roots and underground stems that are present in the duff and mineral soil. This practice produces no erosion in the surface above the slope except on very shallow shale soils.

THE average bank requires only one or two inches of top dressing for plant growth; sterile banks need somewhat more.

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EXPERIMENT STATION

F-388182

Fertilizer has brought tall succulent weeds in quickly on the right half of this mulched bank, in contrast to slower growth on the unfertilized left half.

F-403598

Following application of calcium metaphosphate on this fill at the rate of 400 pounds per acre, both natural growth and planted species showed tremendous growth response.

COMMERCIAL FERTILIZERS require much less labor than do soil dressings, and are easier of application, but they do not take the place of other dressings for road-bank improvement in all cases because they do not supply the biological activity needed to improve growing conditions.

EXTEME caution is needed to avoid using too much commercial fertilizer, particularly on cut banks that are likely to dry out quickly. Light applications are always safer than too heavy applications. In general it is safe to conform to the local agricultural practices. A complete 4-8-4 fertilizer, for example, may be safely applied at the usual rate of 400-500 pounds per acre. Heavier applications are both unnecessary and dangerous.

THE use of lime on acid road banks may but retard the natural invasion of native plants thriving best in acid soil. Yet it is impossible to obtain a growth of some grasses and legumes without lime. Consequently, it is well worthwhile to consult the county agent about the local soils, and to harmonize the use of fertilizer and lime with other plans for naturalizing the road banks.

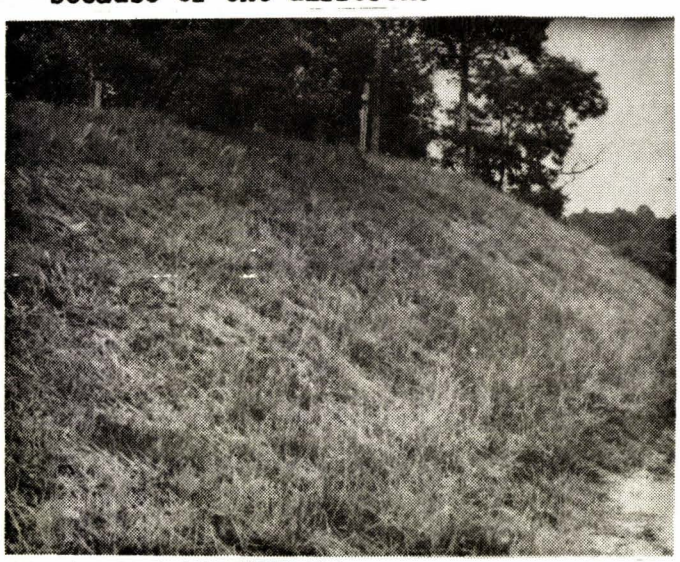
SEEDING AND PLANTING are resorted to as a means of obtaining special landscaping effects, or to increase the representation of attractive local plants, or to obtain a sod on low banks and wide shoulders that are to be kept mowed. They are of greater importance, however, as a temporary means of holding the surface until an invasion of local species can take over the job of stabilization and naturalization. They are rarely if ever used alone to obtain these effects, however, but only after preliminary loosening of the soil, applying top soil, fertilizing, mulching or other special treatment, as local conditions may demand.

F-298966

Broadcast orchard-grass held this fill in place.

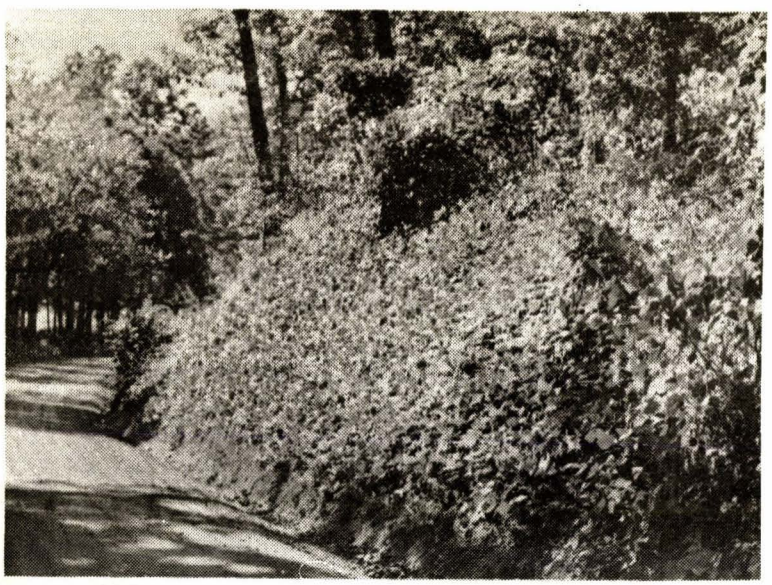
WHETHER or not to seed mulched banks depends on what seed the mulch contains. If weeds cut in the fall are used, seed will be plentiful; but spring-cut weeds have little seed.

MIXED seed is best on all larger projects, because of the different site requirements of different species. Above the range of Bermuda grass in the southern Appalachians a successful mixture is rye-grass, orchard-grass, and red-top, with some blue grass to form a sod. The grass mixtures should be applied at the rate of 20-30 pounds per acre. Grasses can be sown right on the mulch in wet weather.



F-388165

Italian rye-grass 60 days after sowing on sloped, loosened, top-dressed road bank mulched with wheat straw.



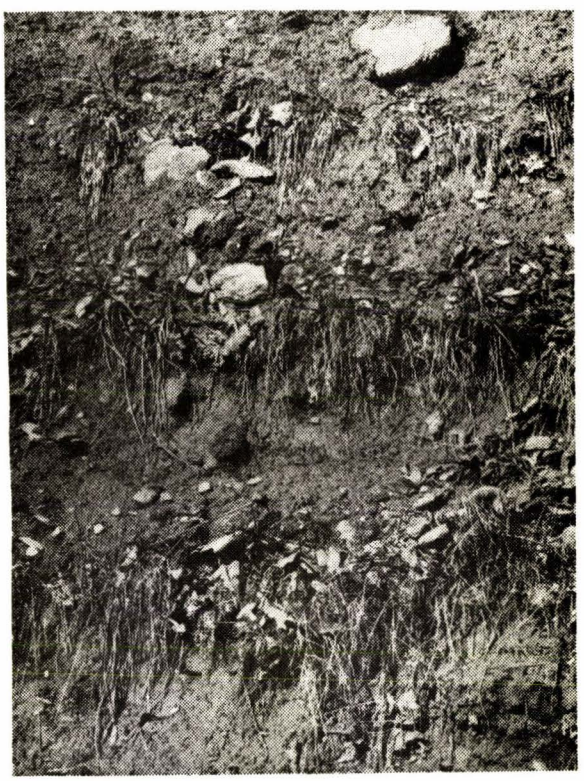
F-373800

After six years on this rich moist site Kudzu is beginning to spread over the trees above the bank and to become a serious pest.

RAPID spread is not the only requisite. Kudzu spreads rapidly but may soon become a pest.

FILLS, with adequate moisture, will rarely need more treatment than seeding with orchardgrass or Italian ryegrass on a loosened surface. The seed of the grains, legumes, and grasses should be raked in very lightly after broadcasting.

SOD planted in furrows on the road bank has rarely proved effective, except where a rich soil aids the roots to penetrate quickly. Elsewhere the sod is frost-heaved and washed out by the spring runoff and erosion. Pot-hole planting of woody shrubs requires mulch protection. Where other methods fail, planting the rich top shoulder of the bank with trailing vines will help to hold the soil and gradually cover the bank from above.



F-307324

Orchard grass sod planted in deep furrows, but in soil of only moderate fertility, was undermined by erosion after exposure to severe frost action.

THE USE OF MULCHES has been particularly successful in assisting the natural invasion of plants on road banks. Mulches serve to provide shade and to check rapid drying, to correct soil instability occasioned through frost action, wind, and water erosion, to prevent frost heaving of young plants, to increase biological activity of the bank soil, and to improve soil structure by addition of organic material. Also, most mulches bring to the banks large quantities of weed and shrub seed. When a topsoil dressing is also used, the mulch serves to keep it from washing away.

F-403632

Mulching brings natural vegetation to the road bank by making conditions more favorable to plant growth.

THE application of mulches in most localities is not only one of the most simple and inexpensive naturalization treatments, but it has the added advantage of being a treatment that may be elaborated upon to any degree necessary. For example, in case natural vegetation does not appear within a reasonable period, the bank may be seeded without further treatment. Fertilizers may be added directly through the mulch. Just how much additional work any particular bank would need depends upon local conditions. No attempt should be made to write rigid specifications; each road bank may call for individual modifications. General techniques may be outlined, but specific techniques have to be developed for each job, depending on local conditions and sources of material.

THE STAKED WEED MULCH is the simplest method known for holding roadside mowings of weeds and briers on a steep slope. Weed mulches are most commonly used in open country, or wherever wild growth such as coarse weeds, briars, grass, meadow hay, etc. can be easily obtained. This material is cut with power mowers, council tools, and scythes, and placed on the road banks either while still green or after drying. If the work is to be done in the winter months, the weeds may be cut in the late summer or early fall, cured like hay, and kept in stacks till used.

F-403629

A good job of using an inexpensive stake and weed mulch on a difficult bank. Four months after stabilization, the heavy weed growth at the bottom of the slope has already achieved naturalization; later, woody shrubs and trees will appear.

IF this mulching material contains a large quantity of briars or long-stemmed weeds, together with some finer grass material, it will hold together in a natural mat and stay in place on moderately steep slopes. If it does not, mulches dry out quickly and may then be blown about by the wind. To prevent this from happening, and to insure against slipping on a steep bank, stakes, poles, or heavy brush are used to hold the mulch in place until vegetation has become established. One way of finding out how much work is needed to hold a mulch is to place material on the bank and then observe the minimum amount of work required to keep it in place.

THE common method of holding a mulch is with stakes 18 to 24 inches long and about 2 inches through. They are made most readily from straight-grained, easily sharpened wood.

IN applying a staked weed mulch, the stakes are usually set first, spaced at whatever distance is necessary to hold a mulch in place, as determined by the length of the mulching material. Frequently stakes are needed only on the upper portion of the bank, or sometimes only in a bottom row with occasional groups on the more difficult portions of the bank. On the average, stakes are set rather uniformly about 2 feet apart, where needed. Commonly, about 6 inches of the stake are left above the surface. A most serious mistake is to cut stakes too short, so that they are thrown out by freezing. Stakes should be at least 18 inches long and sufficiently strong to be driven 12 to 18 inches into the ground.

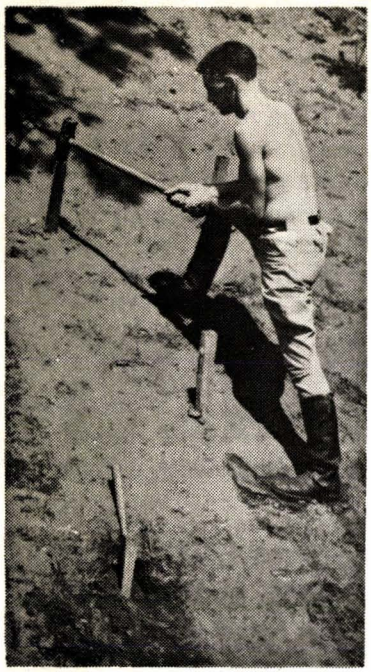
AFTER stakes are in place, the mulching material is laid on this framework to a depth of 2 to 4 inches. The coarser material forms a skeleton framework, and the finer material a continuous mulch as close to the bank as possible. The framework should be placed on the bank by hand, to insure that it is fully supported by the stakes. The mulch must be thick enough to prevent soil movement, but should not interfere with germination and establishment of natural vegetation. A heavy mulch of fine material may cause composting and kill any seed present.

F-373749

The foundation layer has been placed against the stakes by hand; additional material will be pitchforked over this.

F-373750

As the rains beat down the lighter material, the stakes will stand up through the litter and prevent wind scattering.



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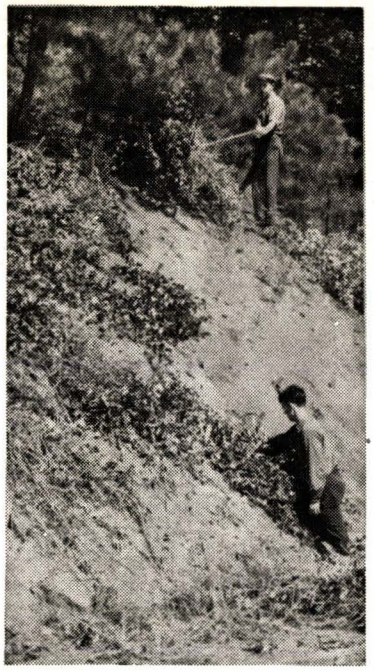

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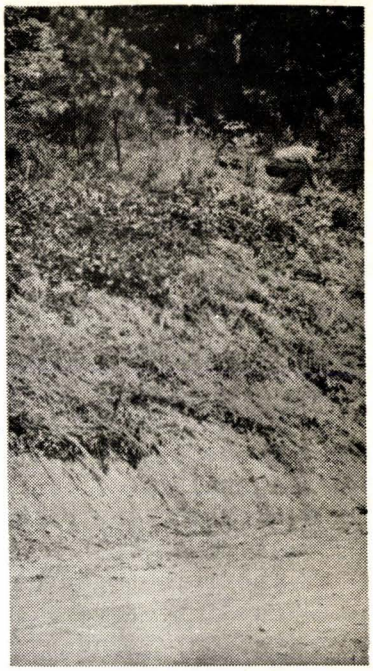

F-373751

After the 18 to 24 inch stakes are driven into the bank at intervals determined largely by local conditions (left), larger pieces of weed material are hand-placed against them (center). Over this skeleton mulch is strewn the smaller weed material and grass (right).

F-403630

A contrast in application of staked weed mulch after one year on rich bank. Bank at left was treated with a loose mulch and soil dressing, largely of plant roots and stems held with stakes and poles. Bank at right shows a matting constructed too thick and tight to favor quick growth.

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